

## 1 One

$$a_i^k(n+1) = \sum_{j=1}^2 w_{ij}^k o_j^k(n) + b_i^k - f_i^k(n), i = 1, 2; k = 1, 2, 3, 4 \quad (1)$$

$$f_i^k(n) = \begin{cases} \gamma F^k(n) \cos(o_i^k(n)), i = 1, \\ \gamma F^k(n) \sin(o_i^k(n)), i = 2, \end{cases} \quad (2)$$

$$o_i^k(n) = \tanh(a_i^k(n)) \quad (3)$$

$$\sum_{k=1}^4 F^k(n) = Mg \quad (4)$$

$$\mathbf{P}_k = (o_1^k(n), o_2^k(n)) \quad (5)$$

$$\phi = (\frac{\mathbf{P}_1 \mathbf{P}_2}{||\mathbf{P}_1|| ||\mathbf{P}_2||}, \frac{\mathbf{P}_1 \mathbf{P}_3}{||\mathbf{P}_1|| ||\mathbf{P}_3||}, \frac{\mathbf{P}_1 \mathbf{P}_4}{||\mathbf{P}_1|| ||\mathbf{P}_4||}) \quad (6)$$

From the initial condition:

$$b_i^k = 0.001,$$

$$o_i^k(0) = 0.0$$

The system will converge to the following result:

$$\phi = (0, 0, 1) \quad (7)$$

## 2 TWO

$$a_{ik}(n+1) = \sum_{j=1}^2 w_{ij} o_{jk}(n) + b_{ik} - f_{ik}(n), i = 1, 2; k = 1, 2, 3, 4 \quad (8)$$

$$f_{ik}(n) = \begin{cases} \gamma F_{k3}(n) \cos(o_{ik}(n)), i = 1, \\ \gamma F_{k3}(n) \sin(o_{ik}(n)), i = 2, \end{cases} \quad (9)$$

$$o_{ik} = \tanh(a_{ik}) \quad (10)$$

$$\mathbf{o} = \begin{pmatrix} o_{11} & o_{12} & o_{13} & o_{14} \\ o_{21} & o_{22} & o_{23} & o_{24} \end{pmatrix} \quad (11)$$

$$\theta = \Theta \mathbf{o} + \beta \quad (12)$$

$$\mathbf{A} \mathbf{F} = \mathbf{b} \quad (13)$$

$$\mathbf{A} = \begin{pmatrix} I_{3 \times 3} \dots I_{3 \times 3} \\ \mathbf{P}_1 \dots \mathbf{P}_k \end{pmatrix} \quad (14)$$

$$\mathbf{F} = (\mathbf{F}_1 \dots \mathbf{F}_k)^\top \tag{15}$$

$$\mathbf{b} = (m(\ddot{\mathbf{P}}_c + \mathbf{g}) \quad \mathbf{I}_G \dot{\boldsymbol{\omega}})^\top \tag{16}$$